U.S. Pat. No. 6,917,304 v. [Itron OpenWay® Integrated Cell Router]

Claim Language	Itron OpenWay® Integrated Cell Router ("Accused Product/device")
1. A method of wireless transmissio n of data in digital and/or analogue	The Accused Product practices a method for wireless transmission of data in digital format through a communications channel, for example, the channel between 2.4 GHz and approximately 2.5 GHz frequency band, among other bands.
format through a communic ations channel	Why Itron Solutions Customers Partners Developers Resources Con
from at least two data sensors to a data processing means said method comprising the step of division of said channel into sub- channels and transmittin g said data from said data sensors respectivel y though said sub- channels accordingly	OpenWay® Integrated Cell Router One of the most critical elements of any smart grid solution is the communications network. Whether transporting meter data, leveraging Wi-Fi technology for field services or performing distribution automation operations, a robust two-way communications network is an essential element for smart metering and smart grid applications. Contact Sales https://www.itron.com/na/solutions/product-catalog/openway-integrated-cell-router
; characteriz ed by	

Technical Data

- » IEEE 802.11b/g/n radio (2.4-2.483 GHz)
 - 3 -7.4 dBi Omni-directional antennas (2.4 GHz)
- » IEEE 802.11a radio (5.725-5.850 GHz)
 - 1 9.1 dBi Omni-directional antenna (5.8 GHz)
- » 900 MHz radio 20dBM conducted power
 - 3 dBi antenna gain
- » Approvals:
 - . FCC CFR Part 15, Class B
 - EN 301 489-17, 300 328, 301 893, 60950
 - IEC 950
 - UL 60950-1
 - CSA 22.2 No. 60950-1
 - UL 579/IEC 60529 IP67 rated for outdoor use
 - IEEE 1613

 $\underline{https://www.itron.com/-/media/feature/products/documents/brochure/openway-integrated-cell-router.pdf}$

Power Outage Backup

- » Battery backup
- » Up to eight-hour hold up time

Flexible Input Power Options

- » AC Powered Version: 100 480 VAC
- » Modular antennas

Next Generation Wireless

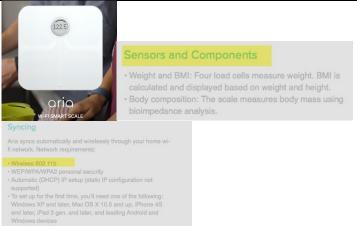
- » Supports 802.11b/g/a/n clients
- » Improves wireless client connectivity by 20%-50%
- » Increases mesh capacity

https://www.itron.com/-/media/feature/products/documents/brochure/openway-integrated-cell-router.pdf

Data is transmitted through the communications channel (the 2.4 GHz frequency spectrum), at least during internal testing and use, from at least two data sensors to a data processing means, e.g., one or more processing units in the Accused Device. On information and belief, the Accused Device includes processing units that perform its intended function(s).

For example, the network may include a local data sensor (e.g., a weight, impedance, temperature, air pressure, and humidity sensors) located on a 802.11b/g device that communicates with the Accused Product's 2.4 GHz communications channel. The 802.11b/g devices necessarily require a lower throughput than 802.11n devices because the 802.11b/g standard has a maximum throughput that is substantially lower than the throughput allowable using 802.11n.

Exemplary 802.11b/g device with weight and impedance sensors:



https://www.fitbit.com/aria. Additional exemplary802.11b/g sensors include wireless temperature, air pressure, and humidity sensors. http://www.omega.com/pptst/wSeries.html

The network, at least during internal testing and use, may in addition include a second data sensor (e.g., camera sensor as shown in the exemplary 802.11n device below) located on a 802.11n device that also communicates with the Accused Device's 2.4 GHz communications channel. These devices using the 802.11n standard have a higher throughput than is allowed under the 802.11b/g standard.

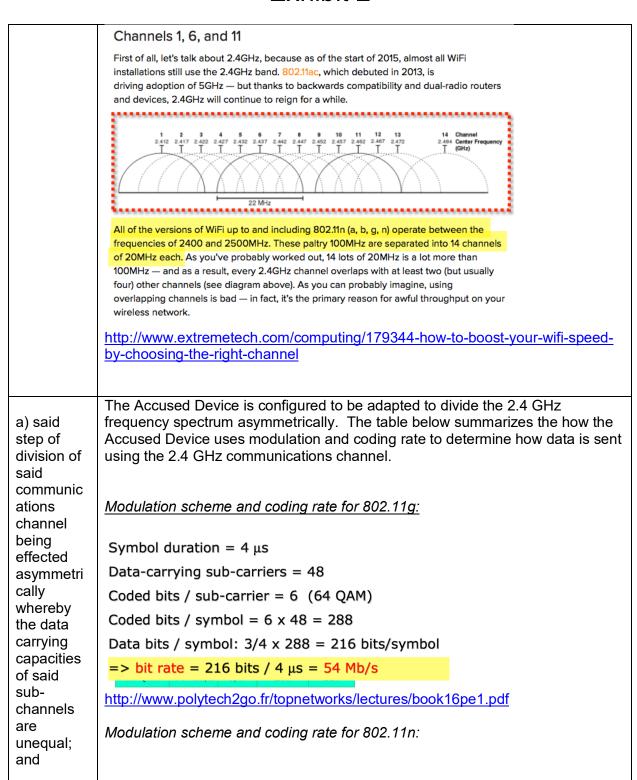
Exemplary 802.11n device with a digital camera and accompanying image sensor (e.g., CMOS, CCD, and other variations):



The cream of the current Fire OS tablet crop, the 8.9-inch device first launched in Sept 2013, and was refreshed this September. with a starting sticker price of \$429 USD. It packs a 2,560 x 1,600 pixel display, a Qualcomm Inc. (QCOM) Snapdragon 805 chip (quad-core, 2.5 GHz), 2 GB of LPDDR3, and 802.11n Wi-Fi.

http://bit.ly/1Ylj6Bd

The Accused Product comprises a multiplexer adapted to effect division of the communications channel into sub-channels, e.g., in the Accused Product the 2.4 GHz frequency spectrum is divided into communications channels for 802.11b/g, and communications channels for 802.11n. For example, there are 14 sub-channels within the 2.4 GHz band. (see below).

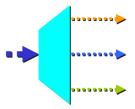


MCS	T	Coding Rate	Spatial Streams	Data Rate (Mbps) with 20 MHz CH		Data Rate (Mbps) with 40 MHz CH	
Index	Type			800 ns	400 ns (SGI)	800 ns	400 ns (SGI)
0	BPSK	1/2	1	6.50	7.20	13.50	15.00
1	QPSK	1/2	1	13.00	14.40	27.00	30.00
2	QPSK	3 / 4	1	19.50	21.70	40.50	45.00
3	16-QAM	1/2	1	26.00	28.90	54.00	60.00
4	16-QAM	3/4	1	39.00	43.30	81.00	90.00
5	64-QAM	2/3	1	52.00	57.80	108.00	120.00
6	64-QAM	3 / 4	1	58.50	65.00	121.50	135.00
7	64-QAM	5/6	1	65.00	72.20	135.00	150.00
8	BPSK	1/2	2	13.00	14.40	27.00	30.00
9	QPSK	1/2	2	26.00	28.90	54.00	60.00
10	QPSK	3 / 4	2	39.00	43.30	81.00	90.00
11	16-QAM	1/2	2	52.00	57.80	108.00	120.00
12	16-QAM	3 / 4	2	78.00	86.70	162.00	180.00
13	64-QAM	2/3	2	104.00	115.60	216.00	240.00
14	64-QAM	3 / 4	2	117.00	130.00	243.00	270.00
15	64-QAM	5/6	2	130.00	144.40	270.00	300.00
16	BPSK	1/2	3	19.50	21.70	40.50	45.00
31	64-QAM	5/6	4	260.00	288.90	540.00	600.00

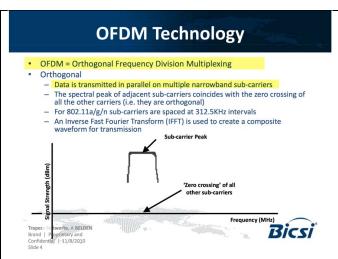
http://airmagnet.flukenetworks.com/assets/whitepaper/WP-802.11nPrimer.pdf

Both 802.11g and 802.11n traffic is handled through an OFDM (orthogonal frequency division multiplexing) multiplexing scheme whereby data in a communication channel is split into N parallel data streams or multiple "subcarriers" (i.e., sub-channels). The OFDM scheme for the 802.11n standard allows for the 802.11n to handle higher data rates than 802.11g and earlier standards.

An OFDM system takes a data stream and splits it into N parallel data streams, each at a rate 1/N of the origin rate.



http://www.polytech2go.fr/topnetworks/lectures/book16pe1.pdf

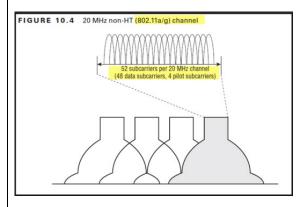


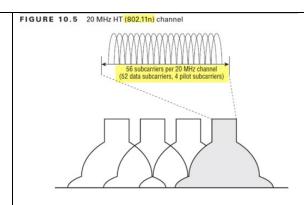
https://www.bicsi.org/uploadedfiles/PDFs/Conferences/singapore2010/day2/2.8 %20802.11n%20Deployment%20-%20Alfred%20Chan,%20Trapeze.pdf

The communications channel is divided asymmetrically whereby data-carrying capacity of the sub-channels are unequal. 802.11g (20 MHz channel) data is divided into 52 sub-carriers (sub-channels) and 802.11n (20 MHz channel) data is divided into 56 sub-carriers (sub-channels). Using the 20MHz channel for 802.11n allows connection with legacy devices using 802.11a/g 20 MHz channels.

- · Frequency Division
 - 802.11a/g 20MHz channels: 52 sub-carriers (48 data, 4 pilot)
 - 802.11n 20MHz channels: 56 sub-carriers (52 data, 4 pilot)
 - 802.11n 40MHz channel: 114 sub-carriers (108 data, 6 pilot)
- Multiplexing
 - Blocks of data are multiplexed across the sub-carriers
 - Data is modulated on the channel using BPSK, QPSK, 16 or 64 QAM with FEC

https://www.bicsi.org/uploadedfiles/PDFs/Conferences/singapore2010/day2/2.8 %20802.11n%20Deployment%20-%20Alfred%20Chan,%20Trapeze.pdf





http://mrncciew.com/2014/10/19/cwap-802-11n-introduction/

The data-carrying capacity of the sub-channels are unequal -- 802.11g has a maximum data rate of 54 Mb/s and 802.11n has a maximum data rate of about 300 Mb/s.

MCS		Coding Rate	Spatial Streams	Data Rate (Mbps) with 20 MHz CH		Data Rate (Mbps) with 40 MHz CH	
Index	Туре			800 ns	400 ns (SGI)	800 ns	400 ns (SGI)
0	BPSK	1/2	1	6.50	7.20	13.50	15.00
1	QPSK	1/2	1	13.00	14.40	27.00	30.00
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3	16-QAM	1/2	1	26.00	28.90	54.00	60.00
4	16-QAM	3 / 4	1	39.00	43.30	81.00	90.00
5	64-QAM	2/3	1	52.00	57.80	108.00	120.00
6	64-QAM	3/4	1	58.50	65.00	121.50	135.0
7	64-QAM	5/6	1	65.00	72.20	135.00	150.0
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31	64-QAM	5/6	4	260.00	288.90	540.00	600.0

http://airmagnet.flukenetworks.com/assets/whitepaper/WP-802.11nPrimer.pdf

Symbol duration = $4 \mu s$

Data-carrying sub-carriers = 48

Coded bits / sub-carrier = 6 (64 QAM)

Coded bits / symbol = $6 \times 48 = 288$

Data bits / symbol: 3/4 x 288 = 216 bits/symbol

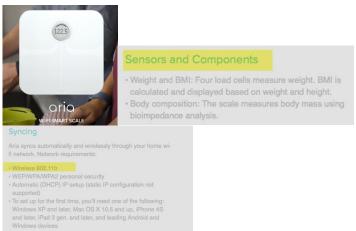
=> bit rate = 216 bits / 4 μ s = 54 Mb/s

http://www.polytech2go.fr/topnetworks/lectures/book16pe1.pdf

b) the data rate required for data transmissio n from said local sensors differing substantiall y between said at least two sensors; and

The accused product is 802.11b/g/n compliant and therefore is configured to adapt to both types of sensors, one which has 802.11b/g capability and the other which has 802.11n capability. The local data sensors (e.g., sensor(s) of the exemplary 802.11b/g device shown below, sensor(s) of the exemplary 802.11n device) to groups of sub-channels in accordance with different data rate requirements from the local sensors.

Exemplary 802.11b/g device with weight and impedance sensors:



https://www.fitbit.com/aria. Additional exemplary802.11b/g sensors include wireless temperature, air pressure, and humidity sensors. http://www.omega.com/pptst/wSeries.html

The network, at least during internal testing and use, may in addition include a second data sensor (e.g., camera sensor as shown in the exemplary 802.11n device below) located on a 802.11n device that also communicates with the Accused Device's 2.4 GHz communications channel. These devices using the 802.11n standard have a higher throughput than is allowed under the 802.11b/g standard.

Exemplary 802.11n device with a digital camera and accompanying image sensor (e.g., CMOS, CCD, and other variations):



The cream of the current Fire OS tablet crop, the 8.9-inch device first launched in Sept 2013, and was refreshed this September. with a starting sticker price of \$429 USD. It packs a 2,560 x 1,600 pixel display, a Qualcomm Inc. (QCOM) Snapdragon 805 chip (quad-core, 2.5 GHz), 2 GB of LPDDR3, and 802.11n Wi-Fi.

http://bit.ly/1Ylj6Bd

For example, when an 802.11b/g device communicates with the Accused Product, because the device can only send data at the data rate of the slower 802.11b/g standard, the Accused Product assigns the 802.11b/g device to an

802.11b/g channel. 802.11b/g data is allocated to the 48 data sub-channels (see below) in accordance with the data rate requirements of the 802.11b/g device's sensor, with 54 Mbps being the maximum data rate allocable to the 802.11 b/g device.

Symbol duration = $4 \mu s$

Data-carrying sub-carriers = 48

Coded bits / sub-carrier = 6 (64 QAM)

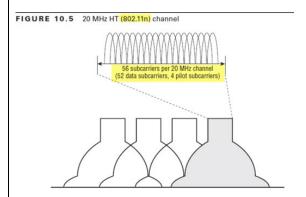
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For example, when an 802.11n device communicates with the Accused Product, because the device can sends data at the substantially higher data rate of the 802.11n standard, the Accused Product assigns the 802.11n device to an 802.11n channel. 802.11n data (from e.g., the 802.11n device's video sensor) is allocated to 52 sub-channels (see below) in accordance with the data rate requirements of the 802.11n device's sensor, with 300 Mbps being the maximum data rate allocable to the 802.11n device.



http://mrncciew.com/2014/10/19/cwap-802-11n-introduction/

The data-carrying capacity of the sub-channels are unequal -- 802.11g has a maximum data rate of 54 Mb/s and 802.11n has a maximum data rate of 300 Mb/s.

MCS		Coding	Spatial	Data Rate (Mbps) with 20 MHz CH		Data Rate (Mbps) with 40 MHz CH	
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=> bit rate = 216 bits / 4 μ s = 54 Mb/s

http://www.polytech2go.fr/topnetworks/lectures/book16pe1.pdf

c) allocating data from said local data sensors to respective ones or groups of said subchannels in accordanc e with the data carrying capacities of said subchannels.

The Accused Product includes is configured to allocate data from said local data sensors (e.g., sensor(s) of the exemplary 802.11b/g device shown below, sensor(s) of the exemplary 802.11n device) to groups of sub-channels in accordance with different data rate requirements from the local sensors.

Exemplary 802.11b/g device with weight and impedance sensors:



Sensors and Components

- Weight and BMI: Four load cells measure weight. BMI is calculated and displayed based on weight and height.
- Body composition: The scale measures body mass using bioimpedance analysis.

Syncing

Aria syncs automatically and wirelessly through your home w

• Wireless 802.11b

- WEP/WPA/WPA2 personal security
 Automatic (DHCP) IP setup (static IP configuration not
- To set up for the first time, you'll need one of the following Windows XP and later, Mac OS X 10.5 and up, iPhone 4S and later, iPad 3 gen. and later, and leading Android and Windows devices

https://www.fitbit.com/aria. Additional exemplary802.11b/g sensors include wireless temperature, air pressure, and humidity sensors. http://www.omega.com/pptst/wSeries.html

The network, at least during internal testing and use, may in addition include a second data sensor (e.g., camera sensor as shown in the exemplary 802.11n device below) located on a 802.11n device that also communicates with the Accused Device's 2.4 GHz communications channel. These devices using the 802.11n standard have a higher throughput than is allowed under the 802.11b/g standard.

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For example, when an 802.11b/g device communicates with the Accused Product, because the device can only send data at the data rate of the slower 802.11b/g standard, the Accused Product assigns the 802.11b/g device to an 802.11b/g channel. 802.11b/g data is allocated to the 48 data sub-channels (see below) in accordance with the data rate requirements of the 802.11b/g device's sensor, with 54 Mbps being the maximum data rate allocable to the 802.11 b/g device.

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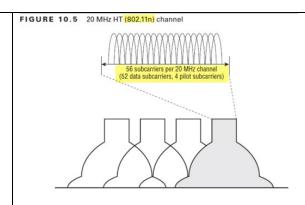
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For example, when an 802.11n device communicates with the Accused Product, because the device can sends data at the substantially higher data rate of the 802.11n standard, the Accused Product assigns the 802.11n device to an 802.11n channel. 802.11n data (from e.g., the 802.11n device's video sensor) is allocated to 52 sub-channels (see below) in accordance with the data rate requirements of the 802.11n device's sensor, with 300 Mbps being the maximum data rate allocable to the 802.11n device.



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